FOREST PEST MANAGEMENT
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BIOLOGICAL EVALUATION OF PESTS AFFECTING VEGETATION IN SUMMIT AND SIGNAL CAMPGROUNDS, MARIPOSA RANGER DISTRICT, SIERRA NATIONAL FOREST

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PSW FOREST AND RANGE EXPERIMENT STATION
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ABSTRACT

Two campgrounds, Summit and Signal, on the Mariposa Ranger District were examined for pests and vegetation conditions. Four significant pests were observed at Summit Campground: dwarf mistletoes on sugar pine and white fir, fir true mistletoe, and annosus root disease of white fir. The lack of vehicular controls is leading to site and soil deterioration. Areas of the campground have overstocked stands. Three management alternatives, no change, relocate campground, and rehabilitate campground, are discussed as to their long-term effects on pests and the vegetation.

Two pests are present in Signal Campground, white fir dwarf mistletoe and annosus root disease of white fir. The application of the same management alternatives and the small differences from Summit Campground are discussed.

INTRODUCTION

On October 3, 1983 we met with Dick Hambrock from the Mariposa Ranger District, Sierra National Forest and visited Summit and Signal Campgrounds. The purpose was to examine the vegetation in the campgrounds and determine what pests were present and how they were affecting the vegetation. This was one of a series of campground evaluations on the Sierra National Forest by Forest Pest Management to provide pest information for consideration during the development of vegetation management plans in developed recreation areas.

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On October 6, 1983 we met with Dick and Mark Smith, Silviculturist, Sierra National Forest, at Summit Campground to discuss our findings. After examining examples of the pests observed, we discussed possible management alternatives for the two recreation areas.

SUMMIT CAMPGROUND

Summit Campground is moderately developed with 11 camping sites. It is primarily used as an overflow area for Yosemite National Park in the summer and as a hunter's camp in the fall. The campground has tables and vault toilets, but other developments, including roads and camping spurs, are not well-defined.

The stand is three-layered with an overstory of predominant white firs, sugar pines, and incense-cedars. The middle layer is about 60 years old and is comprised of codominant, sawtimber-sized white firs, sugar pines, and incense-cedars. The understory contains these same three species plus dogwood and California black oak. Several giant sequoia have been planted, along with an unknown 2-needle horticultural pine. Areas of brush in the campground have manzanita, whitethorn, Ribes, and bear clover. Site quality was measured as site class I and high II (Dunning and Reineke).

The level of stocking varies throughout the campground. A large area in the center of the campground has only a few trees, the soil is bare and lacks a litter layer. This is primarily a result of unrestricted vehicular and foot traffic and is resulting in soil compaction and erosion. Other areas of the campground, especially around the perimeter, are heavily stocked, with basal areas up to 400 sq. ft./ac. recorded.

A number of potential pest organisms were observed. Those of most significance include sugar pine dwarf mistletoe (Arceuthobium californicum) on sugar pine, white fir dwarf mistletoe (A. abietinum f.sp. concoloris) on white fir, fir true mistletoe (Phoradendron bolleanum ssp. pauciflorum) on white fir, and annosus root disease (caused by Fomes annosus) in white fir stumps and root systems of windthrown white fir. The locations of these pests are shown on the enclosed maps. Potentially important pests presently not active include fir engraver (Scolytus ventralis) in white fir, mountain pine beetle (Dendroctonus ponderosae) in sugar pine, pine engravers (Ips spp.) in sugar pine, and pocket gophers (Thomomys sp.) in conifer regeneration. Other pests of less significance that are present include incense-cedar mistletoe (P. juniperinum ssp. libocedri) and incense-cedar rust (Gymnosporangium libocedri) on incense-cedar.

MANAGEMENT ALTERNATIVES

1. No Change in Management. In general, the site and vegetation will continue to deteriorate. The limited restrictions on vehicular and foot traffic will result in adverse effects to the soil, such as erosion and compaction, and injury to the vegetation, such as wounding of tree roots

and butts. Health and vigor of existing vegetation will decrease. It is unlikely that natural regeneration in heavily used areas will occur.

Both types of mistletoe will intensify and spread in white fir. Buildup of true mistletoe in the tops of white firs will encourage top-killing by fir engravers. Dwarf mistletoe in white fir will increase and may spread to the surrounding understory. Heavy buildup could increase the probability of successful fir engraver attacks in the larger trees and the understory could be severely damaged. Dwarf mistletoe in sugar pine will also intensify and spread. Heavy witches' brooms will develop, generally in the lower and midcrowns of trees with old infections. Trees severely infected and with large witches' brooms will have a good probability of successful attacks by either or both the mountain pine beetle and the red turpentine beetle (D. valens).

The presence of F. annosus in the root systems of older white fir will result in continued windthrow of these trees. Most of this will occur during fall and winter storms when soils are wet, snow loads may be heavy, and winds high. Regeneration of white fir within annosus root disease centers will be limited as smaller trees are usually killed by the fungus.

Bark beetles could become a mortality factor, especially of sugar pine. As previously mentioned, trees heavily infected by dwarf mistletoe are more prone to successful bark beetle attacks. Because of the aggregating nature of the pheromone emitted by the insects, surrounding healthy host trees could be attacked in addition to the initially attacked trees. Trees in overstocked areas also are more susceptible to successful bark beetle attacks and have a higher probability of mortality. This probability increases when other stresses, such as that caused by drought, occur.

2. Relocate Campground. Relocating the campground would eliminate the present and potential problems inherent with the existing location. A temporary relocation would provide the time to aggressively rehabilitate the present Summit Campground. If it is decided to permanently relocate the campground, then it is suggested that the services of Forest Pest Management be obtained to provide pest and vegetation information for the new site prior to any construction activities.

3. Rehabilitate Campground. A rehabilitation program for Summit Campground would require a number of activities, from engineering changes to vegetation improvement. These steps are outlined below:

a. A major existing problem is the mostly unrestricted travel patterns by people and vehicles. More clearly designating roads and camping spurs would encourage self-regulation by users. Additional encouragements would include signs, paving, and natural and artificial barriers. The objective would be to establish vehicular and foot traffic patterns that would decrease the amount of deterioration of the site.

b. Following regulation of the traffic, artificial revegetation of understocked and barren areas could take place. This would help to reduce soil erosion, improve soil and site conditions, provide barriers and screening, and provide future replacement trees. Local (indigenous) vegetation should be utilized in these tasks.

Several brush species are available to provide ground cover in barren areas and to direct foot traffic where needed. These include manzanita, whitethorn, and Ribes. As the manzanita grows larger, it should serve as effective screening. All three of these shrubs will probably have to be obtained locally. The quickest method would be to transplant small bushes from the surrounding forest. Irrigation of the transplants, at least during the first growing season, might be necessary. A second approach would be to collect seeds and either plant an area directly or grow small containerized stock for several years and then plant. Another technique that might be successful would be to attempt to vegetatively propagate cuttings from local bushes. It is known that the technique of mound layering will work for gooseberry (Ribes). The effectiveness of vegetative propagation techniques for the other two species is not known, although both will sprout from the roots following death of the tops. Branches of greenleaf manzanita growing from a plant will reportedly root if they contact the ground.

In addition to shrubs, revegetation with trees may be desired in some areas. A variety of species is available, including ponderosa pine, Douglas-fir, incense-cedar, giant sequoia, California black oak, and dogwood. Some of these would become overstory trees, while others would stay in the understory and aid in screening. Artificial regeneration with sugar pine and white fir is not recommended because it probably will become infected by the pests (mistletoes and annosus root disease) that are present. Also, because of the preponderance of these trees in the overstory, they will probably regenerate naturally in sufficient numbers to retain their presence in the campground.

c. Although parts of the campground need to be regenerated, other areas would benefit from a reduction in stocking. These areas are primarily around the perimeter of the campground. Two thinning situations exist in these overstocked stands.

In situations where predominants are severely affected by dwarf mistletoe and the stand is overstocked, the affected trees should be removed. These trees are overmature, becoming decadent from the mistletoes and are likely to die during the next severe drought. Their removal will also lessen the lateral spread of dwarf mistletoe to the understory. Because of their size, care will have to be taken during falling to minimize injury to residual trees. Damaged trees should be considered for removal.

The other situation for thinning is in younger overstocked aggregates. These should be thinned from below where possible, with an attempt to sanitize by removing infected or damaged trees.

SIGNAL CAMPGROUND

Signal Campground is a small group camp used sporadically during the summer. It is minimally developed with a few picnic tables and two vault toilets. Its use is not expected to increase greatly in the future. Because of the indistinct boundaries and layout of the campground locations of pests were not detailed.

The vegetation in Signal Campground is similar to Summit in species composition and age distribution. The primary overstory species are white fir, sugar pine, and incense-cedar. A small amount of ponderosa pine and red fir is also present. The understory is made up of the three primary species, with a large proportion of white fir. Shrub species include manzanita, whitethorn, and gooseberry. The site class was measured as a site I and high II (Dunning and Reineke).

The principal pest in the campground is white fir dwarf mistletoe. It exists at moderate levels throughout much of the white fir overstory. Some of the larger white firs have old, open-faced bole cankers caused by past mistletoe infections. These trees have been marked for removal during a planned timber sale in the area.

The other pest observed near the center of the campground was F. annosus in a white fir stump. The center is regenerating to brush, sugar pine, incense-cedar, and white fir. In time, the white fir may be killed by the fungus, but the other species should be unharmed. At present, no new damage is visible to the nearby vegetation.

The management alternatives for Signal Campground are similar to those discussed for Summit Campground. A few differences in details do exist. If it is desired to maintain the opening in the center of the campground for group activities, then artificial regeneration is not necessary. Because of the limited use, there is not much soil disturbance and the need for traffic control is less. The activity that would be most beneficial to the campground is a thinning, mainly from below. This may be partly accomplished during the planned timber sale. A thinning of the understory, selecting against white fir, would also be beneficial.

PEST-SPECIFIC MANAGEMENT TECHNIQUES

In both campgrounds, if management activities are undertaken, it is recommended that two pest prevention activities be followed. These are designed to minimize future damage from F. annosus and pine engravers.

All conifer stumps should be treated with borax (sodium tetraborate decahydrate, EPA Reg. No. 1624-94) immediately after the trees are cut. A light sprinkling of the granular pesticide to cover the stump surface is effective in preventing infection by air-borne spores of the fungus.

Green pine slash should be treated to minimize a population buildup by pine engravers. This is especially important for any slash created between January and June. Proper treatment could include piling and

burning, cutting slash 3 inches and larger in diameter into short (< 18 inches) segments and scattering in open areas, piling and covering the pile tightly with clear plastic, chipping, or crushing thoroughly with a tractor.

BIOLOGIES OF PEST ORGANISMS

Annosus Root Disease (Fomes annosus). Infection of true firs by F. annosus is initiated when airborne spores are deposited on freshly cut stump surfaces or basal wounds of true firs. After germination, the fungus grows into the stump and root system, decaying the wood and killing small roots. When root contact occurs with roots from surrounding live true firs, the fungus can cross over and begin decaying this new root system. This type of local spread results in the formation of expanding disease centers.

Fomes annosus is not a strong competitor in attacking dead tissue, therefore, it must rapidly colonize new stumps and wounds to be successful. Once established in stump systems, however, it may persist as a saprophyte for many years, the length of time depending in part on the mass of woody tissue in which the fungus exists. After occupying woody tissue, it will slowly decay the moist tissue, which can result in the development of cavities in stumps. These cavities function as moist chambers where the leathery, poroid conks develop and produce spores.

Fomes annosus can rapidly kill true fir seedlings and saplings. Larger trees usually decline slowly as roots are decayed. In unsuppressed white firs this decline may involve a reduction in height growth and reduction in needle retention in the upper crown. As the root system decays, the tree may be windthrown or predisposed to attack by fir engraver beetles.

Sugar Pine Dwarf Mistletoe (Arceuthobium californicum); White Fir Dwarf Mistletoe (A. abietinum f.sp. concoloris). Dwarf mistletoes are parasitic seed plants that require living host tissue to survive. Each of these two mistletoes infect only one host in the campgrounds.

Dwarf mistletoes are major causes of growth loss and reduced vigor and can be mortality factors, especially in a complex with bark beetles and drought. They can also form large witches' brooms in tree crowns.

Mature seeds are produced in late summer and fall and are forcibly ejected from the fruit. They are covered by a sticky, gelatinous coating and adhere on contact. The seeds germinate in the spring and infect twigs less than two-years-old near the needle base. In two to three years, shoots appear and these produce fruit in another two to three years. The infections in the branch can survive as long as the host tissue is alive.

Spread of dwarf mistletoe is relatively slow. Individual seeds are usually shot a horizontal distance of 15 to 20 feet, although plants high in crowns may send seeds over 100 feet when assisted by wind. Horizontal spread in an even-aged pine stand averages one to two feet

per year with a vertical spread rate up the crown of about four inches per year. The average annual vertical spread of dwarf mistletoe in white fir is 3 inches or less.

The intensity of dwarf mistletoe infection in individual trees is rated by a 6-class system. Healthy, non-infected trees are rated as 0, while trees with severe infections throughout their crowns are classified as 6. This system takes into account both the amount of infection and its distribution throughout the crown.

Mountain Pine Beetle (Dendroctonus ponderosae). The four major hosts of this bark beetle are ponderosa, lodgepole, sugar, and white pines. Evidence of successful attacks include pitch tubes, boring dust in bark crevices, woodpecker holes in the bark, longitudinal egg galleries in the inner bark, and fading crowns.

The mountain pine beetle normally has a one year life cycle. Adults attack trees mainly during early and mid-summer, excavating a straight vertical gallery in the inner bark. Eggs are distributed singly along the length of this gallery and hatch in 1 to 2 weeks. The larvae bore small galleries in the inner bark at right angles to the egg gallery and overwinter. As the larvae mature, they construct oval cells in the inner bark in which they pupate and transform to the adult stage. The adults may feed briefly in the inner bark prior to emergence in the summer.

As with all Dendroctonus bark beetles, the success of the mountain pine beetle is dependent on a complex set of chemical messengers -- pheromones. When the initial attacks by female and male beetles are successful, these "pioneer" beetles release pheromones which attract other beetles of the same species to the area. The effect of this concentration or aggregation then is to insure mating success in a favorable habitat. If beetles are abundant in an area at the time the pheromones are released and if stand density is high, the probability of group-tree killing due to beetle attacks is greatly increased.

Fir Engraver (Scolytus ventralis). The principal hosts of the fir engraver in California are white and red fir. This insect can cause tree mortality, top-killing, and patch killing of cambium, as well as infest green logs and windthrown trees. Evidence of attack includes reddish boring dust, branch flagging, pitch streamers, horizontal egg galleries, and crown fading.

This engraver beetle generally has a one year life cycle with adults attacking during the summer. The male and female beetles mate in a nuptial chamber that has been excavated in the inner bark. From this chamber, a horizontal egg gallery is bored for several inches in either direction. The female lays eggs in niches along this gallery. In 1 to 2 weeks, the eggs hatch into larvae that begin mining at right angles to the egg gallery. The larvae generally overwinter and pupate in small cells at the end of their galleries in the spring. Within a few weeks the new adults emerge.

Evidence for the use of pheromones by fir engravers is not as clearcut as in pine bark beetles. Initial attacks appear to be random. However, after a few attacks on a tree, it appears that an attractant is produced. True firs with annosus root rot have a higher probability of being successfully attacked than healthy trees.

White Fir Mistletoe (Phoradendron bolleanum ssp. pauciflorum). The true mistletoes are usually considered to be curiosities, but they can be serious pests where individual trees are of high value. Species of Phoradendron are essentially "water parasites" and are less demanding of their hosts than dwarf mistletoes.

True mistletoe infections are spread mainly by birds - including robins, blue-birds, thrushes, and cedar waxwings - that feed on the berries. Birds digest the pulp of the berries and excrete the living seeds, often depositing them onto susceptible trees. A viscous coating and hair-like threads on the outer surface of the seeds attach them firmly to twigs and branches, where they germinate and infect the host tissues.

Young or small trees are seldom infected by leafy mistltoes. In nearly all cases, initial infection occurs on larger or older trees because birds prefer to perch in their tops. Severe buildup of mistletoe often occurs in an already-infected tree because birds are attracted to and may spend prolonged periods feeding on the mistletoe berries.

Trees heavily infected by true mistletoe are weakened, reduced in growth rate, and sometimes killed. Weakened trees are predisposed to attacks by insects and often die during drought or other periods of stress. Heavy infection of white fir can result in top kill in combination with the fir engraver (Scolytus ventralis). Branches and tree tops heavily-laden with true mistletoe often break during wind storms and trunk swellings may provide an entrance point for decay fungi, increasing the hazard to people and property in campgrounds and other developed sites.

Pine Engravers (Ips spp.). These beetles are common throughout western North America. They most commonly attack freshly cut pine logs, slash and breakage, as well as tops and limbs of living trees. Top-killing by engraver beetles may precede or occur in conjunction with attacks by Dendroctonus bark beetles. When suitable host material is plentiful, such as slash or drought-stressed pines, large numbers of beetles may develop and aggressively attack healthy green pines. Young pines from 2 to 8 inches in diameter and the tops of older trees are the host material most at risk. This is particularly true of densely stocked groups of trees. Fortunately, outbreaks are usually of short duration and seldom last more than one season.

Attacking adults may be found under the bark, typically constructing three or four egg galleries from a central nuptial chamber. These galleries run parallel with the wood grain and assume a Y or H pattern. The galleries are kept clear by the adults and consequently the reddish boring dust accumulates in piles near the entrance holes. The dust is

particularly visible on horizontal host material such as blowdown. On vertical trees it catches on bark flakes and crevices, and spider webs. In the area of these campgrounds, two to four generations can be expected per year - two or three summer generations following spring emergence of adults and possibly another that will overwinter as adults, either under the bark or in forest litter.

SUMMIT CAMPGROUND

KEY TO MAPS

1. White fir stump nearby with F. annosus; crown thinning - suspect tree infected.
2. True mistletoe in incense-cedar.
3. F. annosus in white fir stump.
4. Incense-cedar rust.
5. Dwarf mistletoe in sugar pine - rating 6.
6. True mistletoe in white fir.
7. Incense-cedar with dead tops/limbs - low to moderate failure potential.
8. True mistletoe in white fir.
9. White fir leaning to west with 1/2" crack on east face - decay fungus fruiting; hazardous tree.
10. Incense-cedar rust.
11. Dwarf mistletoe in sugar pine - rating 1.
12. White fir stump with F. annosus; no white fir nearby.
13. True mistletoe in white fir.
14. Dwarf mistletoe in sugar pine - rating 5.
15. True mistletoe in white fir.
16. True mistletoe in white fir - very heavy in top.
17. True mistletoe in incense-cedar.
18. White fir with large, decayed wound at base; flat/sunken face; dead top - potential failure.
19. True mistletoe in incense-cedar.
20. True mistletoe in white fir.
21. True mistletoe and rust in incense-cedar.
22. True mistletoe in incense-cedar.
23. Windthrown white fir with roots decayed by F. annosus.

24. Dwarf mistletoe in white fir - rating 5.

25. Area with recent pocket gopher mounds.

26. Heavy true mistletoe in incense-cedar.

27. Dwarf mistletoe in sugar pine - rating 6.

28. True mistletoe in incense-cedar.

29. True mistletoe and dwarf mistletoe - rating 1 - in white fir.

30. Dwarf mistletoe in sugar pine - rating 6.

31. Dwarf mistletoe in white fir - rating 4.

32. Dwarf mistletoe in white fir - rating 5.

33. Dwarf mistletoe in white fir - rating 4.

34. White fir stump with F. annosus.

35. True mistletoe in white fir; dead top is potential failure.

36. Rust in incense-cedar.

37. True mistletoe and dwarf mistletoe - rating 4 - in white fir.

38. Dwarf mistletoe in sugar pine - rating 6.

39. Dwarf mistletoe in white fir - rating 1.

40. Dwarf mistletoe in white fir - rating 5.

41. Dwarf mistletoe in white fir - rating 2.

42. Dwarf mistletoe in white fir - rating 3.

43. Dwarf mistletoe in sugar pine - rating 1.

44. Dwarf mistletoe in sugar pine - rating 4.

45. Dwarf mistletoe in sugar pine - rating 5.

46. Dwarf mistletoe in sugar pine - rating 6.

47. Dwarf mistletoe in sugar pine - rating 6.

48. True mistletoe in white fir - slight top-kill developing.

49. True mistletoe in white firs.

50. True mistletoe in white firs.

51. Dwarf mistletoe in sugar pine - rating 1.

52. True mistletoe and dwarf mistletoe - rating 3 - in white fir.

53. Dwarf mistletoe in sugar pine - rating 6.

54. True mistletoe in incense-cedar.

+ Match with Sheets 2, 3, 4

13 →

← 15 20 →

19 →

+ Match with Sheet 2

JNTAIN ROAD

1

2

21

LEGEND

SCALE
INCH = 30 FEET APPROXIMATE

Sugar Pine		Toilet
white fir		
cedar		Table
Dog wood	—•	Barrier
Redwood		Log
Water Developed		Brush
	..—	water way

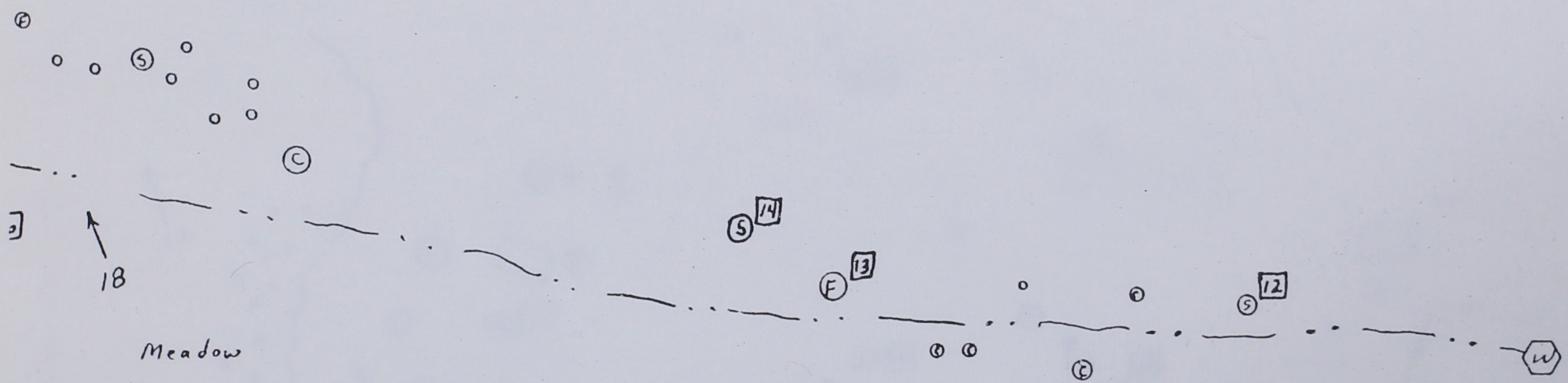
Location of Pests - see Key - Oct. 1983
+ Match with Sheet 4

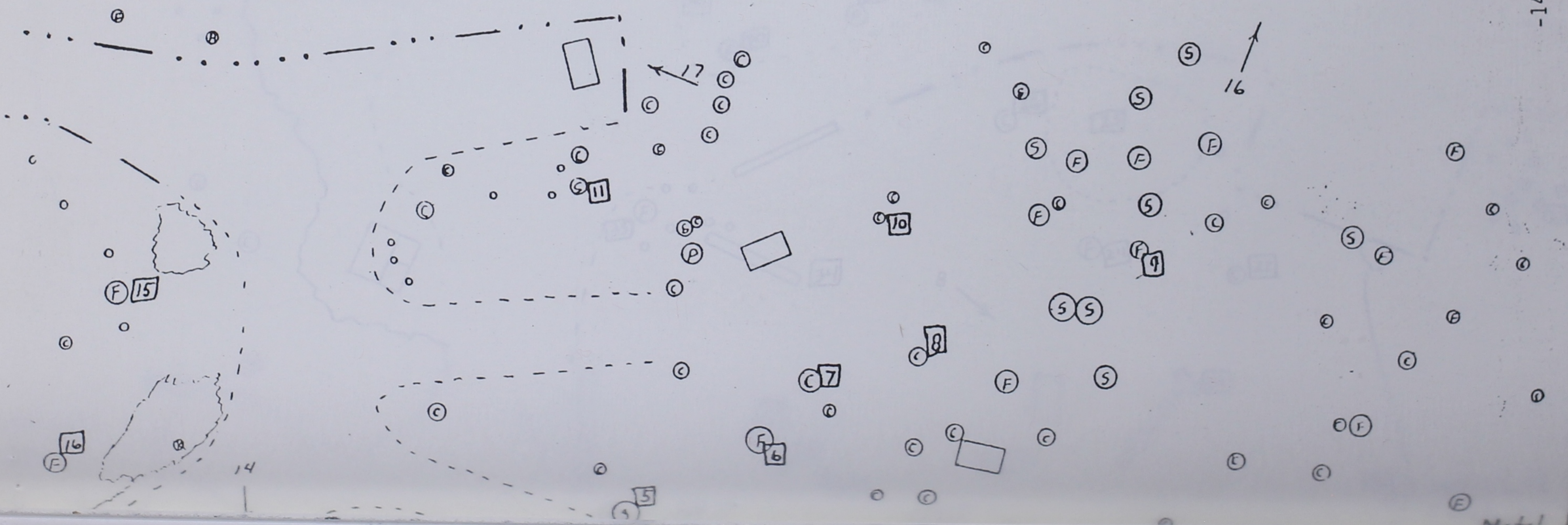
S
N

Nov. 1982
R. L. Hembrock

Match with Sheet 3

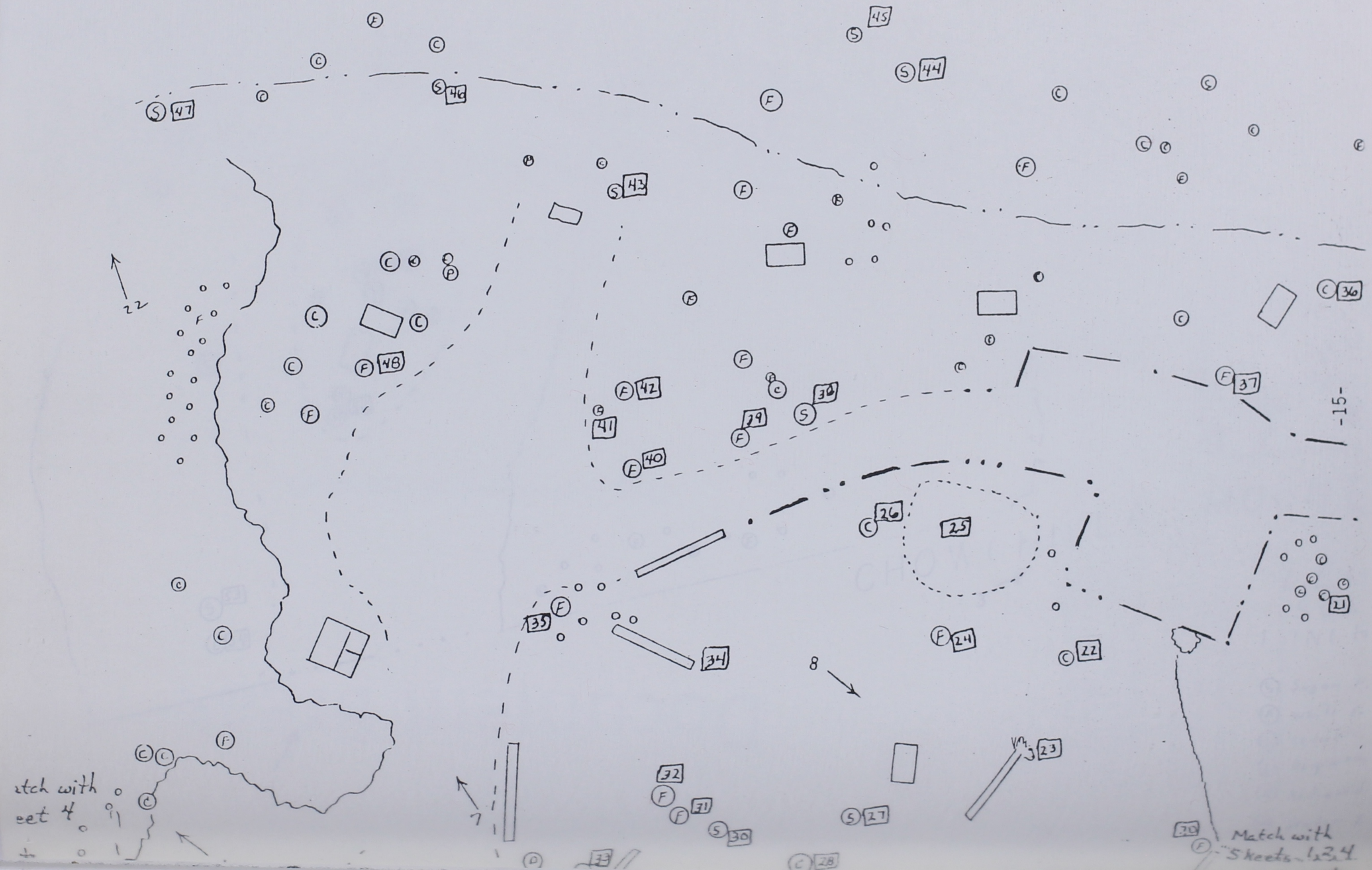
SHEET 2





SHEET 3

Match with sheet 2 +



-15-

Match with Sheet 4 +

Match with Sheets 1,2,4 +

Match with Sheet 3

6

5

Match with Sheets 1, 2, 7

13

12

9

11

10

4

3

CHOWCHILLA

MOUNT

LEG
SCA
1 INCH

(S) Sugar P.
(F) White f.
(C) Cedar
(D) Dog wood
(R) Redwood
(W) Water L